IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

K-2128

Applicant	:	Masahiro Irie
Title	:	PHOTOCHROMIC MATERIAL
Serial No.	:	10 / 649,868
Filed	:	August 28, 2003
Group Art Unit	:	1626
Examiner	:	Deborah C. Lambkin

Hon. Commissioner of Patents
P. O. Box 1450, Alexandria, VA 22313-1450

DECLARATION UNDER RULE 132

Sir :

I, Masahiro Irie, declare as follows:

1) I obtained Doctor of Engineering from Osaka University in the year 1974.

2) I have worked at Osaka University and Kyushu University where I have conducted research in photochromic materials since 1975.

3) I am the inventor of the invention of USSN 10 / 649,868.

4) I have understood the Official Action of May 31, 2005, and /or have had the same explained to me.

5) In order to demonstrate the importance of the particular structures of the compounds of current Claims 1-9, I have conducted the following experiment.

6) The compounds listed below in Tables 1-3 were prepared using the reactions and procedures described in the present specification. Some of these compounds are representative of the present invention, while others are representative of the compounds of the Japanese patents cited as references in the Official Action of December 16, 2004. Specifically, the compounds of Table 1 represent conventional diarylethenes having alkoxy groups. The compounds of Table 2 represent the diaryletnenes of the present invention. The compounds of Table 3 represent the diarylethenes of the Japanese patents cited as references against the present invention in the Official Action of December 16, 2004.

After obtaining the compounds of Tables 1-3, each was tested using the same procedures as in the present specifications in order to measure the ring opening quantum yield ($\Phi c \rightarrow o$) and the ring closing quantum yield ($\Phi o \rightarrow c$). The objective was to provide compounds having a ring opening quantum yield of less than 10^{-3}.

Table 1. Previous Diarylethenes with Alkoxy Groups *)

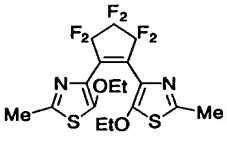
	$\Phi c \rightarrow o$	$\Phi o \rightarrow c$
	3.7×10^{-3} (at 547 nm)	0.34 (at 324 nm)
	3.3×10^{-2} (at 543 nm)	0.34 (at 313 nm)
	0.04 (at 492 nm)	0.14 (at 366 nm)

Table 2. Present Diarylethenes with Alkoxy Groups

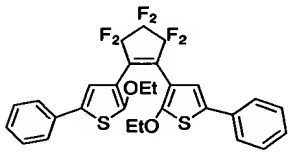
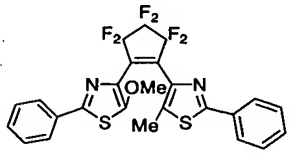
	$\Phi c \rightarrow o$	$\Phi o \rightarrow c$
	$< 2.0 \times 10^{-5}$ (at 625 nm)	0.44 (at 309 nm)
	2.5×10^{-4} (at 625 nm)	0.48 (at 310 nm)
	3.3×10^{-4} (at 555 nm)	0.29 (at 313 nm)

Table 3. References *)

	$\Phi_{C\rightarrow O}$	$\Phi_{O\rightarrow C}$
	1.6×10^{-3} (at 600 nm)	0.44 (at 298 nm)
	4.0×10^{-3} (at 540 nm)	0.28 (at 313 nm)

*) The references were measured by the same procedure as in the invention. Measuring wavelengths used were different depending on the compounds. The wavelengths are written under the compound.

7) From the above results, several important observations may be made and a conclusion drawn therefrom.

First, the presence of fused benzene rings attached to the core thiophene rings in the conventional diarylethenes in Table 1 do not afford a ring opening quantum yield of less than 10^{-3} despite the fact that these compounds contain two lower alkoxy groups attached to the core thiophene rings.

Second, the presence of directly bonded, but not fused, aryl rings and two lower alkoxy groups attached to the core thiophene rings in the compounds of the present invention in Table 2 do afford a ring opening quantum yield of less than 10^{-3}.

Third, the presence of directly bonded, but not fused, aryl rings, but only one lower alkoxy group attached to core thiophene rings in the compounds of the Japanese patents cited in the Official Action of December 16, 2004, in Table 3 do not afford a ring opening quantum yield of less than 10^{-3}.

Fourth, in view of the above observations, I conclude that only with the present compounds as reflected in Claims 1-9 of the present application - which have both : 1) directly bonded aryl rings or aryl rings bonded via a divalent group (R^2 and R^5) and 2) two lower alkoxy groups attached to the core thiophene rings (R^1 and R^4) can a ring opening quantum yield of less than 10^{-3} be obtained.

The results afforded by the compounds of Claims 1-9 are important and commercially significant. The record or image of an optical memory medium or optical display material of a photochromic material may disappear under ambient light, such as room light. When the quantum yield of the ring opening reaction (know as "ring opening quantum yield") of a diarylethene compound in a closed ring form is on the order of 10^{-2}, the record or image and disappear in several hours under room light. Thus, it is desirable to attain a reduced ring opening quantum yield of less than 10^{-3}. The compounds of the present inventions as represented by Claims 1-9 accomplish this result.

Further, the importance and commercial significance of obtaining a ring opening quantum yield of less than 10^{-3} may be readily appreciated from Examples 1-4 (paragraphs [0041] - [0071] of the present specification wherein it is seen that with a ring opening quantum yield of less than 10^{-4} the compounds of present Claims 1-9 exhibit photochromism such that upon exposure to irradiation with visible light little or no fading was observed).

8) On the basis of the above, I am of the opinion that the particular structures of the present compounds as reflected in Claims 1-9 and the ring opening quantum yields afforded thereby (less than 10^{-3}) would not have been expected by one skilled in the art at the time the present invention was made. Further, it appears that there is not even a recognition in the art of record that the low quantum yield less than 10^{-3} results in greatly reduced fading when subjected to visible light.

9) I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine, or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

10) Further, declarant sayeth not.

Masahiro Irie

Name

Masahiro Irie

Signature

August 19, 2005

Date